

**Defense Advanced Research Projects Agency**

Submitting Proposals

The responsibility for carrying out the DARPA SBIR Program is vested in the Program Management Office. The DARPA Coordinator and Manager of the program is Dr. John K. Meson.

DARPA invites small business community to send proposals directly to DARPA under the following address:

Defense Advanced Research Projects Agency  
Program Management Office  
ATTN: Dr. John K. Meson  
1400 Wilson Boulevard  
Arlington, VA 22209

The proposals will be processed in the Program Management Office and distributed to appropriate technical offices for evaluation and action.

DARPA identified 17 technical topics to which the small business can respond. A brief description of each topic is included below.

SB85-001      TITLE: High Resolution Semiconductor Analytical Techniques

DESCRIPTION: Compound semiconductors, such as the GaAs-based III-V alloys, and HgCdTe, potentially will have widespread use in DoD systems. Rapid, high spatial resolution (1 MICRON) instruments are needed for materials development and quality control proposed if these materials systems are to be developed to maturity suitable for manufacturing purposes. Proposed concepts/approaches should have one or more of the following potential capabilities: 1. Measure lateral alloy uniformity to  $\pm 0.002$  mole fraction with a lateral spatial resolution 1 MICRON x 1 MICRON and depth resolution  $< 200$  Å; 2. Alloy composition vs. depth to  $\pm 0.002$  mole fraction with depth resolution  $< 50$  Å and lateral resolution 50 MICRON x 50 MICRON; 3. Minority carrier properties (e.g., lifetime and mobility) with spatial resolution similar to those stated in 1. And 2. above. The proposed techniques should be compatible with commercialization (e.g., not dependent on a fixed major facility), and incorporation and use in an electronics-manufacturing environment.

New Micro scale characterization techniques which may not meet the spatial resolution goals described above, but would provide novel and unique insight into the nature and properties of compound semiconductor structures, also will be considered. First priority, however, will be given to new techniques which do offer the potential to meet the spatial resolution goals.

SB85-002      TITLE: Military Applications of Conducting Polymers

DESCRIPTION: In the later 1970's, the materials field of conducting and semi conducting organic polymers was opened with discovery of the Prototype material, doped polyacetylene, (CH)<sub>x</sub>. In broad terms these materials have conceptual applications as classical semiconductor device structures, lightweight wires, electro magnetic shielding, transparent conducting coatings, batteries, and perhaps optical fibers. While the stability and other Properties of (CH)<sub>x</sub> initially precluded "real world" use of conducting (CH)<sub>x</sub> in these applications, subsequent development of other much more robust conducting polymers (as well as advances in (CH)<sub>x</sub> itself) suggest that these materials now deserve detailed considerations for applications to military systems and problems. This task seeks to identify and develop specific concepts for the application of conducting polymers in military systems. Proposals must elucidate clearly and concisely the potential advantages of using conducting polymer materials compared to any presently used material, and/or elucidate a unique system capability which will result. Polymers which exhibit electronic or ionic conduction are of interest. Proposals which comprise largely of research and characterization of potential new conducting polymer systems will not be considered in this task.

SB85-003      TITLE: Electro-Optic Techniques for VLSI Interconnect

DESCRIPTION: A major limitation to achieving significant speed increases in VLSI lies in the metallic interconnects. They are costly not only from the charge transport standpoint but also from capacitive loading effects. The Department of Defense, in pursuit of the fifth generation supercomputer, will be investigating alternatives to the VLSI metallic interconnects, especially the use of optical techniques to transport the information either inter or intrachip. Interests include such areas as source and detector integration onto a VLSI chip, the optical control of integrated electronic devices, optical switching elements, reconfigurable optical channels, and all optical generalized cross bar switching networks.

Guided channels may be considered for intrachip interconnects, but the advantages of unguided optical channels should play a major role in solving interchip and interprocessor communications. Once the electronic signals have been converted to optical signals, optical imaging and holography may be used to guide the optical beam to its destination, which would likely be a photo-detector to another chip. One may go so far as to envision reprogrammable interconnects employing the optical phenomena of four-wave mixing. The bottom line in realizing opto-electronic interconnects is a need for research into nonlinear optics because it is the nonlinear aspect of optics that lies at the root of many of the desired operations – from integrated light sources, through optical switched and reconfigurable channels, to four wave mixing. Consideration will be given to proposed studies into nonlinear optical materials, new device concepts, optical/electronic integration schemes, and interconnect architecture.

SB85-004      TITLE: Lightweight Robot Manipulator Technologies

DESCRIPTION: There is a need for robotic arms and end effectors which are lightweight, fast and accurate. This new generation of robots will probably be constructed from carbon-reinforced epoxy, metal matrix composites, or non-rigid metallic frame. Target performance characteristics are as follows: accuracy  $\pm 200$  micrometers; speed – 3 to 5 meters per second; and carrying capacity – 100 kilograms. Other desirable innovations include non-linkage design with continuous degrees of freedom and lightweight direct drive actuators with distributed power.

SB85-005      TITLE: Single Mode Fiber Optic Switch

DESCRIPTION: Unattended fiber optic telemetry systems have stringent requirements for long-term reliability. One way of enhancing system reliability is to allow the use of alternate optical paths in the event of electronics failure. Redundant optical paths are now implemented by using optical couplers, which permanently split the optical paths and energy. An alternate method would be through the use of an optical switch or commutator, in which the optical path is physically changed by a mechanical means. Mechanical switches are made more difficult by the shift of the fiber optic telemetry implementation to single mode optics with light core diameters of 5 microns. The resulting tolerances for a match between optical waveguides are one micron or less.

The objective of this effort is to develop and demonstrate a single mode fiber optic commutator, or multiple pole switch. A six pole, two to six position commutator which will switch a single mode (1.3 micron wavelength color) network between two to six configurations is desired, but there would be use for a single pole dual throw optical switch.

The switch would be required to operate only infrequently (hours to years between operations) and for a limited number of times (greater than 10, less than 10 ten thousand). The switch/commutator must be low power in switching and completely passive while maintaining position. The switch/commutator should be rugged enough to survive military deployment. The switch must be able to be deployed in one position, lay passive for years, then reliably switch on command. In performing the switching operation, the switch/commutator should not require an extensive control network.

The offeror should demonstrate his innovative concept through design and a limited demonstration.

SB85-006      TITLE: VLF Sources

DESCRIPTION: High output, non-explosive, broadband acoustic sources are required to implement proposed active surveillance systems' concepts. Operational constraints dictate systems that are simple, reliable and easy to handle at sea. Source levels from 190 dB to 230 dB re micropascal/Hz are needed over the frequency range 5-40 Hz.

SB85-007      TITLE: Expendable String of Fiber Optic Sensors

DESCRIPTION: Develop an inexpensive, thin diameter, low power passive fiber optical acoustic sensor string which could be deployed in a number of configurations. The need is for a throw away, all glass sensor string which could be attached to a weapon body or other device. This body would contain the necessary electronics and signal conditioning equipment. Applications such as mines require long operation on battery power, thus the device should consume low levels of power. The device should be small to allow packaging and deployment in canisters. The sensors should be capable of operation at deep ocean depths.

Offerors should include a description of the sensor physical configuration, modulation techniques, sampling rates, sensitivity, and dynamic range.

SB85-008      TITLE: Arctic Communications Techniques

DESCRIPTION: With increased activity in Arctic regions, communication systems will be needed to gather information from sensors and data buoys deployed above 70 degrees North. Communication concepts and techniques not based on satellite relay are needed for low to medium data rates (300-2,400 baud). Further, a two way link (simplex) is required to allow control of remote sensors from CONUS sites. Emphasis should be on simple, reliable, and power efficient systems for the remote sensor end.

SB85-009      TITLE: Remote Sensing of Sea Ice Thickness

DESCRIPTION: The thickness of sea ice affects a wide variety of Arctic activities from ice breaker operations to the delivery of weapons through the Arctic ice cap. A reliable means is needed for estimating sea ice thickness from remote sensing platforms such as aircraft, satellites and data buoys. Concepts and techniques proposed must provide for wide area coverage with frequent sampling at resolutions appropriate to missions.

SB85-010      TITLE: Ice Penetration Techniques

DESCRIPTION: In the higher latitudes, particularly above 75° N, it often will be necessary to penetrate sea ice when deploying sensors and/or weapons. Sea ice varies in thickness and strength as a function of age. First year ice ranges 30 cm to .5 m thick while multiyear ice will be from 3-4 meters thick. The picture is further complicated by the presence of keels (bottom side) and ridges (top side) caused by the interaction of ice flows in motion.

Practical techniques are needed for delivery of weapons and sensors through the ice from both below and above the ice cover. Rapid deployment (seconds) is important in some instances but in many cases slower penetration (hours) is acceptable. The concepts and techniques proposed should address the full range of environmental and operational requirements.

SB85-011      TITLE: High Power Density Electro-Chemical Energy Sources

DESCRIPTION: Many military systems would benefit greatly from electro chemical power sources that are well beyond the present state of the art in power density and that have one or more other unique properties; e.g., minimal volume or weight and/or conformability. Examples include man portable systems, undersea vehicles and space systems. While the theoretical bounds on power density are well defined by thermodynamic and physical properties, the degree to which one can approach the theoretical bounds is determined by constraints imposed by electrodes and packaging ("container") materials and design. This task seeks innovative concepts for materials and package design which will make possible a substantial advance in the power density of fieldable electro chemical power sources. Here an electro chemical power source can mean a battery or a fuel cell; also, both primary and secondary power sources are of interest. The ultimate goal is a power density of 400 watts/kg in a fully packaged power source. While the task goal is stated in terms of power density (watts/kg), concepts which might lead to other unique attributes (watts/cm<sup>3</sup>, conformability, etc.) or unique combination of such properties will also be considered.

SB85-012      TITLE: High Power Density Components for Electromagnetic Launchers

DESCRIPTION: Electromagnetic launchers are being considered for a variety of missions including anti aircraft, armor and ballistic missile defense. Innovative concepts are needed in a variety of technologies relating to the repetitive operation of such devices as practical weapon systems. High current opening switches and acceleration concepts that mitigate or eliminate opening switches are needed. High power density electrical power supplies and pulse forming networks are desired to minimize the total system weight. Techniques for reducing and rejecting the waste heat generated in switches, rails, inductors and other components are desired for both ground and space based systems. Materials and methods for reducing erosion and increasing life of rails and sliding electrical contacts would be valuable.

SB85-013      TITLE: Development of Surface Current Measurement Probes for Detection of Electromagnetic Field Induced Boyd Resonances

DESCRIPTION: Present measuring techniques for electromagnetic field induced currents on conducting bodies are sensitive to all of the natural resonances of the body. It is known that these body resonances divide naturally into two parts, one set being due to "electric" modes on the body, and the other to "magnetic" modes. A surface charge probe is sensitive to only the electric modes and hence will only be able to detect half of the body resonances. To date, there has been no attempt to construct a dual sensor which will be sensitive to only the magnetic modes. This effort will undertake the design of such a mode sensor and its testing in a laboratory setting.

SB85-014      TITLE: Two-Dimensional Electro Magnetic Scattering Analysis

DESCRIPTION: An important problem in Radar Cross Section (RCS) analysis is the scattering from an infinite cylinder of arbitrary cross-sectional shape and material composition. Numerical techniques suitable for predicting the RCS at resonant frequencies and above are desired. Such codes should be capable of treating inhomogeneous media (real and imaginary parts of the permittivity and permeability being functions of position). Ideally the technique would successfully analyze sharp spatial discontinuities in material parameters (such as thin resistive sheets) and anisotropies.

SB85-015      TITLE: Molecular Electrical Devices

DESCRIPTION: Existing approaches to the development of very high-density submicron electronic and electromechanical devices and circuits rely primarily on the refinement of standard lithographic processes. Such techniques appear to place the minimum features that can be reliably mass-produced at between .3 to 1.0 micron. Researchers in biotechnology are developing fabrication techniques that may result in the capability to fabricate features below 0.1 micron. Such concepts include self-ordering molecular films and arrays, biochemical deposition and delineation, and the use of large molecules as circuit elements. This task would result in a survey of such emerging capabilities, identification of centers of excellence, and the development of a research plan that addresses the technical barriers involved in achieving useful devices. The study should include the following specific efforts: as assessment of the ultimate stability of molecular devices; conceptual designs for electrical interconnection to submicron and molecular devices; analysis of thermal dissipation; conceptual designs for the equivalent to the transistor, diode and other electrical components; a survey of potential applications other than electronic circuit elements.

SB85-016      TITLE: Executive Interfaces for Advanced Workstations on a Local Area Network Connected to the ARPAnet

DESCRIPTION: Develop prototype integrated executive interface to the services available on advanced workstations on a local area network connected to the ARPAnet. The interfaces should be visually oriented and require no significant user training for the effective use. The services should include electronic mail, text preparation with integrated graphics, project planning aids, calendars, spreadsheets, databases, and the like. The user interfaces screen bitmap graphics in a Berkeley UNIX 4.2 distributed system environment. The deliverable should represent a significant advance beyond commercial products currently available in the market place.

SB85-017      TITLE: Interfacing of Hosts to Networks

DESCRIPTION: Small and inexpensive network interface device: To support a number of networking developments and to make such technology easily usable by the military, there is a need to support the interfacing of hosts to networks and interfacing networks together in a cheap, low power and small size device. With the emerging digital technology, it would seem that this should be possible to do. Cost goals should be \$1,000 per unit in production quantities for a device capable of support throughput in the range of 50 kbps and performing functions such as interfacing a local network into the packet switched internetwork system.